ABUNDANCES OF Na, Ca, Mg AND Al IN THE ATMOSPHERES OF K SUPERGIANTS OF THE SMALL MAGELLANIC CLOUD

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ABSTRACT. The abundances of chemical elements Na, Ca, Mg and Al of the nine K-supergiants in SMC was investigated by a method of models of atmospheres. With this goal the CCD-spectrograms with high resolution was used. It is showm that all stars have a deficit abundances of iron from -0.40 to -0.97 dex. relatively of Sun. The some diff erences of contents of elements Na, Ca, Mg and Al in atmospheres of stars SMC and our Galaxy relatively of content of iron was found.

Key words: Stars: K-supergiants SMC ; stars: abundances of chemical elements.

1. Introduction

The Large and Small Magellan Cloud (LMC and SMC) together with our Galaxy enter into a Local System of a cluster of galaxies and consequently the research of all objects which are included in the LMC and the SMC represents doubtless interest from testing of evolution of a Local System, including our Galaxy. The last years due to application of large telescopes and modern equipment of a radiation it was possible to receive the important data about parameters and chemical structure of a number of bright objects LMC, SMC and stars YC, in main, for supergiants. It is seem, that for these stars, as well as for stars of the population II types and thick disk of a Galaxy the common deficit of metals. The spectra were obtained in an European Southern observatory (CHILE) on a telescope equipped EMMI, and on 3.6 telescope with K spectrograph. The spectra obtained with EMMI have the resolution $R = \lambda/\triangle\lambda = 30000$. Spectra obtained on K - spectrograph $R \sim 20000$. The relation a signal-to- noise $S/N \sim 100$. A spectral interval$\triangle\lambda - (500 - 630nm)$ and (580 - 700nm).. Early the nine stars were investigated us of method of model of atmospheres and send in publication. In the given work the results of a research of contents Na, Ca, Mg and Al in atmospheres of nine stars SMC (from them three stars earlier are resulted are not investigated Hill (1997) and Hill et al. (1997) by method of synthetic spectra. The spectral lines of this elements are blended of lines other elements. For stars - supergiants it is necessary to take into account deviations from LTE and an approximation of plane geometry. As have shown accounts, the effects of a deviation from LTE and spherical geometry influence in an opposite direction on intensity of lines of absorption. The grid of models Bell et al. (1976) was used. The lines were selected from the list of lines, as well as their input parameters - force of oscillators, of energy of lower layers of excitation of atom or ion (Kurucz, 1992, 1993). The synthetic spectra for stars was calculated on code Tsymbal (1996). The list of lines was made for each line of investigated elements in interval 50 Å. The average contents of chemical elements in atmosphere of the Sun were taken from work Grevesse and Sauval (1998). The parameters of atmospheres of stars PMMR 23, PMMR 27, PMMR 48, PMMR 102, PMMR 144, PMMR 145 are taken from Hill (1997). For stars PMMR 219, PMMR 390, PMMR 667 parameters of atmospheres were determined on equivalent widths of lines of iron. Effective temperature (T_{eff}) was determined from a condition of independence of the contents of neutral iron $lg(Fe/H)$ from potential of excitation. The accounts were made for an interval of temperatures from 4000 to 4500 K through 100 K. Acceleration of gravity log g was selected from ionization equilibrium for elements Fe, Ti, V. The turbulent velocity V_t was selected from a condition of absence of correlation between the contents of iron $\lg(Fe/H)$ and of equivalent width (W_λ) of different lines FeI. V_t varied in an interval from 3 km/s up to 4.5 km/s. An error in definition(determination) of a turbulent velocity of ± 0.5 km/s . In Table 1 the parameters of atmospheres of stars for choice of models of atmospheres from a grid Bell et al. (1976) and for their interpolation are represented.

Table 1: Physical parameters of stars

Star	T_{eff}(K)	$\log g$	V_t (km/s)	[M/H]
PMMR23	4200	0.2	4.0	-0.8
PMMR27	4300	0.1	3.0	-0.6
PMMR48	4300	0.3	3.5	-0.6
PMMR102	4300	-0.2	3.5	-0.6
PMMR144	4100	-0.7	3.5	-0.9
PMMR145	4300	0.3	3.0	-0.6
PMMR219	4200	0.3	3.5	-0.5
PMMR390	4200	0.2	4.0	-1.0
PMMR667	4300	0.2	3.5	-0.4

Table 2: Abundances

Star PMMR	[Na/H]	σ	N	[Na/H] Hill
23	-0.36	0.17	4	-0.55
27	-1.20	0.14	2	-0.88
48	-0.83	0.06	3	-0.62
102	-0.63	0.35	5	-0.62
144	-1.16	0.14	3	-0.77
145	-1.02	0.11	3	-0.91
219	-0.10	-	1	-
390	-0.50	-	1	-
667	-0.34	0.23	2	-
Star PMMR	[Mg/H]	σ	N	[Mg/H] Hill
23	-0.71	0.18	2	-0.75
27	-	-	-	-
48	-1.23	-	1	-
102	-0.74	0.34	4	-0.40
144	-	-	-	-
145	-0.83	0.21	2	-0.47
219	-0.39	0.14	2	-
390	-1.28	-	1	-
667	-	-	-	-
Star PMMR	[Al/H]	σ	N	[Al/H] Hill
23	-0.97	-	1	-0.71
27	-1.27	0.02	2	-0.85
48	-1.17	-	1	-0.79
102	-	-	-	-
144	-0.87	-	1	-0.87
145	-	-	-	-
219	-0.44	0.09	2	-
390	-	-	-	-
667	-	-	-	-
Star PMMR	[Si/H]	σ	N	[Si/H] Hill
23	-0.71	0.22	5	-0.72
27	-1.14	0.24	6	-0.90
48	-1.10	0.27	2	-0.92
102	-1.04	0.25	10	-0.71
144	-1.07	0.12	2	-0.86
145	-1.00	0.27	5	-0.69
219	-0.87	0.43	5	-
390	-0.90	0.49	2	-
667	-1.08	0.11	2	-

2. Conclusion.

The results of determination of the contents of chemical elements of Na, Ca, Mg and Al researched stars SMC are indicated in Tab. 2. From Table 2 it is visible, that the atmospheres of all investigated of stars have a deficit in the contents of iron on a comparison with the solar ones. For all stars the same method was used. All stars have close photometric and spectral characteristics. The variations of the contents of iron [Fe/H] at selected stars SMC, on all probability, reflect differences primordial of chemical structure of an interstellar medium. The interest represents the contents of elements of α - process in our case the contents of elements Ca, Si. In our Galaxy in atmospheres of stars with a deficit of metals have the enrichment contents of these elements. At investigated stars SMC, on the contrary, the small deficit in the contents Si, Ca to relative iron are observed. The values [Si/Fe] vary from - 0.5dex up to -0.1dex. The contents Ca is more close the contents one for stars with solar content of iron. From all elements, considered by us, noticeable exceed in the contents to relation to iron show Na. It is notes, that at stars - giants of the disk of a Galaxy the enrichment in the contents Na (Komarov, 1999) is detected. This result is agreed in work (Bojarchuk et al., 2001). The magnitude of enrichment depends on a luminosity of a star. With increasing of a luminosity of a star the abundance Na is increased. It is consider, may be, that at stars - supergiants SMC on a stage of dwarfs was proceeded with convective outflow of products of nuclear processes in surface of stars.

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